CLAIMS

We claim:

1. A fluid dispenser comprising:

a reservoir chamber;

a dispense chamber which is substantially in line with the reservoir chamber; and

a means for transferring fluid between the dispense chamber and the reservoir chamber based on pressure differential between the dispense chamber and the reservoir chamber.

2. The fluid dispenser of claim 1 wherein the reservoir chamber is coaxial with the dispense chamber.

3. The fluid dispenser of claim 2 wherein the means for transferring fluid includes a check valve operative to allow a flow of fluid from the reservoir chamber to the dispense chamber and to disallow a flow of fluid from the dispense chamber to the reservoir chamber.

4. A fluid dispenser as claimed in claim 3 further comprising a ball check valve insert, a ball, the ball mating with the ball check valve insert, the ball check valve insert being adjacent to the dispense chamber, the ball check valve insert being coaxial with the dispense chamber and the reservoir chamber.

5. A fluid dispenser as claimed in claim 3 further comprising a piston, the piston in

between the reservoir chamber and the dispense chamber.

6. A fluid dispenser comprising:

a barrel having a reservoir chamber, the barrel having an upper portion;

a cap connected to the upper portion of the barrel;

a valve adjacent to the reservoir chamber; and

a coupler having a dispense chamber, the coupler being coaxial with the barrel.

7. A fluid dispenser as claimed in claim 6 wherein the lower portion of the barrel is enveloped by the coupler and further comprising a stop, the stop stopping the downward stroke of the barrel as it moves in the coupler.

8. A fluid dispenser as claimed in claim 7 further comprising a spring which expands and contracts based on the movement of the barrel.

9. A fluid dispenser comprising:

a barrel having a reservoir chamber, the barrel having an upper portion;

a cap connected to the reservoir chamber;

a valve adjacent to the reservoir chamber;

a coupler having a dispense chamber; and

a vent adjacent to the cap, the vent including a first means to maintain constant pressure in the reservoir chamber, a second means to maintain constant pressure in the reservoir chamber,

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and a space, the space being between the first and second means to maintain constant pressure in the reservoir chamber.

10. A fluid dispenser as claimed in claim 9 wherein the first means to maintain constant pressure in the reservoir chamber includes a vent opening, the vent opening being adjacent to the cap.

11. A fluid dispenser as claimed in claim 10 wherein the first means to maintain constant pressure in the reservoir chamber further includes a vent material, the vent material being adjacent the vent opening and composed of hydrophobic material.

12. A fluid dispenser as claimed in claim 11 further comprising a disk, the disk abutting the vent opening and housed within the space.

13. A fluid dispenser as claimed in claim 12 wherein the disk is comprised of a cell foam material.

14. A fluid dispenser as claimed in claim 10 wherein the second means to maintain constant pressure in the reservoir chamber includes a gap between the space and outside the fluid dispenser.

15. A fluid dispenser comprising:

a barrel having a reservoir chamber, the barrel having an upper portion;

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a cap connected to the reservoir chamber;

a valve adjacent to the reservoir chamber;

a coupler having a dispense chamber; and

a vent adjacent to the cap, the vent including a means to allow air to the reservoir chamber and a means to reduce air flow through the means to allow air to the reservoir chamber.

16. A fluid dispenser as claimed in claim 15 wherein the means to allow air to the reservoir chamber includes a vent opening.

17. A fluid dispenser as claimed in claim 16 wherein the means to reduce air flow through the means to allow air to the reservoir chamber includes a vent material composed of hydrophobic material.

18. A fluid dispenser as claimed in claim 16 wherein the means to reduce air flow through the means to allow air to the reservoir chamber includes a cell foam material adjacent to the means to allow air to the reservoir chamber

19. A fluid dispenser as claimed in claim 18 further comprising a second means to allow air to the reservoir chamber.

20. A fluid dispenser as claimed in claim 19 wherein the second means to allow air to the reservoir chamber includes an airgap adjacent to the means to reduce air flow through the means to allow air to the reservoir chamber.

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21. A fluid dispenser comprising:

a barrel having a reservoir chamber, the barrel having a piston at a lower portion of the barrel;

a cap connected to the reservoir chamber;

a valve adjacent to the reservoir chamber; and

a coupler having a dispense chamber, the piston moves in the dispense chamber.

22. A fluid dispenser as claimed in claim 21 wherein the dispense chamber is coaxial with the piston.

23. A fluid dispenser as claimed in claim 22 further comprising a valve, the valve being in between the piston and the reservoir chamber.

24. A fluid dispenser as claimed in claim 23 further comprising a ball check valve insert, a ball, the ball mating with the ball check valve insert, the ball check valve insert being adjacent to the dispense chamber, the ball check valve insert being coaxial with the dispense chamber and the reservoir chamber.

25. A fluid dispenser as claimed in claim 24 further comprising a quad seal, the quad seal being attached to the coupler where the piston and dispense chamber are coupled.

26. Method of assembly of a fluid dispenser, the method comprising the steps of:

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inserting a valve and a valve insert into the lower portion of a barrel;

welding the cap to the upper portion of the barrel;

placing the ball in the check valve ball seat;

snapping the check valve ball seat into the coupler; and

snapping the coupler and barrel together.

27. A method as claimed in claim 26 wherein the step of snapping the coupler onto the barrel includes pushing protrusions on the barrel past indentations on the coupler, thereby maintaining the alignment of the barrel to the coupler during movement of the barrel.

28. A method as claimed in claim 27, prior to snapping the coupler onto the barrel, further comprising the step of:

inserting a quad seal, stop and spring into the coupler.

29. A method as claimed in claim 27 wherein the step of snapping the check valve ball seat into the coupler includes placing the check valve ball seat into grooves which are in the coupler.

30. A method of filling and priming a fluid dispenser, the method comprising the steps of:

providing the fluid dispenser with a cap, a barrel having a reservoir chamber, the barrel being adjacent to the cap, a dispense chamber adjacent to the reservoir chamber, and a nozzle adjacent to the dispense chamber;

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providing a syringe with a tip and a syringe plunger;

opening the cap on the fluid dispenser;

filling the reservoir chamber within the fluid dispenser with fluid;

closing the cap on the fluid dispenser;

placing the tip of the syringe inside the nozzle of the fluid dispenser without requiring the fluid dispenser be turned upside down; and

expanding the plunger of the syringe in order to draw fluid from the reservoir chamber and the dispense chamber into the syringe.

31. A method as claimed in claim 30 further comprising the steps of:

pushing the barrel downward; and

releasing the barrel during the step of expanding the plunger of the syringe in order to draw fluid from the reservoir chamber and the dispense chamber.

32. A method as claimed in claim 30 wherein the step of placing the tip of the syringe inside the nozzle of the fluid dispenser includes using a restrictor on the tip of the syringe in order to securely fit the syringe in the nozzle of the fluid dispenser.

33. A method as claimed in claim 30 further comprising the steps of:

opening the cap after the step of expanding the plunger of the syringe in order to draw fluid from the reservoir chamber and the dispense chamber into the syringe; and

pushing in the plunger of the syringe and releasing the fluid in the syringe into the reservoir of the fluid dispenser.

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34. An automated biological reaction system comprising:

a slide support carousel;

drive means engaging the slide support carousel for moving the slide support carousel;

a consistency pulse application station comprising at least one nozzle for directing a stream of fluid onto a slide which is less than 35 degrees from the horizontal; and

a volume adjust application station positioned above the slide for applying a predetermined amount of fluid on the slide by dropping the fluid onto the slide.

35. A method of placing a consistent amount of fluid on a slide in an automated biological reaction apparatus, the automated biological reaction apparatus having at least one rinse station, the rinse station comprising a rinse station nozzle positioned for directing a stream of fluid onto the slide, the rinse station nozzle connected to tubing which is connected to at least one valve, the valve connected to a bottle containing fluid, the valve controlling the flow of fluid from the bottle to the nozzle, the method comprising the steps of:

turning on the valve for supplying fluid to the nozzle and directing a stream of fluid onto the slide;

waiting until the pressure is substantially equal in the tubing; and

turning off the valve for supplying fluid to the nozzle.

36. A method as claimed in claim 35 wherein the stream of fluid directed onto forms an angle with the horizontal, the angle being less than 35 degrees.

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37. A method as claimed in claim 35 wherein the step of waiting until the pressure is substantially equal in the tubing includes waiting at least 300 mSec.

38. A method as claimed in claim 35 further comprising the steps of:

providing in the rinse station a second valve, the second valve connected to the bottle containing fluid, the second valve controlling the flow of fluid from the bottle to the nozzle;

turning on the second valve for supplying fluid to the nozzle substantially simultaneously with the step of turning on the valve for supplying fluid to the nozzle, and directing a stream of fluid onto the slide;

waiting until the pressure is substantially equal in the tubing; and

turning off the second valve for supplying fluid to the nozzle substantially simultaneously with the step of turning off the valve for supplying fluid to the nozzle.

39. A method as claimed in claim 35 further comprising the steps of:

providing a volume adjust station in the automated biological reaction apparatus, the volume adjust station comprising at least one nozzle positioned above the slide for depositing fluid onto the slide, the nozzle connected to tubing which is connected to a volume adjust valve, the volume adjust valve connected to a bottle containing fluid, the volume adjust valve controlling the flow of fluid from the bottle to the nozzle;

turning on the volume adjust valve and directing a stream of fluid which is substantially perpendicular to the slide after turning off the valve for supplying fluid to the nozzle at the rinse station;

waiting a predetermined amount of time; and

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turning off the volume adjust valve for supplying fluid to the nozzle.

40. A method as claimed in claim 39 further comprising the step of restricting the flow of fluid which is flowing from the volume adjust valve.

41. A method as claimed in claim 35 wherein the rinse station further comprises a second rinse station nozzle positioned for directing a second stream of fluid onto the slide, the second rinse station nozzle connected to tubing which is connected to a second rinse station valve, the second rinse station valve connected to a bottle containing fluid, the second rinse station valve controlling the flow of fluid from the bottle to the nozzle, and further comprising the steps of:

turning on the second rinse station valve for supplying fluid to the second rinse station nozzle and directing a stream of fluid onto the slide;

waiting a predetermined amount of time;

turning off the second rinse station valve for supplying fluid to the second rinse station nozzle;

turning on the valve for supplying fluid to the nozzle and directing a stream of fluid onto the slide, the stream of fluid directed from the rinse station nozzle being at an angle with the horizontal less than the stream of fluid directed from the second rinse station nozzle;

waiting the predetermined amount of time; and

turning off the valve for supplying fluid to the nozzle.

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42. A method of washing a slide in an automated biological reaction apparatus, the method comprising the steps of:

providing a rinse station comprising a first rinse station nozzle and a second rinse station nozzle, the first and second rinse station nozzles positioned to direct a stream of fluid onto the slide;

directing a stream of fluid onto the slide from the first rinse station nozzle with a first momentum for a first predetermined amount of time;

directing a stream of fluid onto the slide from the second rinse station nozzle for a second predetermined amount of time with a second momentum; and

directing a stream of fluid onto the slide from the second rinse station nozzle for a third predetermined amount of time with a third momentum, the third momentum being greater than first or second momentum, the third predetermined amount of time being greater than the first or second predetermined amount of time.

43. A method as claimed in claim 42 wherein the first rinse station nozzle includes a top rinse station nozzle and a second rinse station nozzle includes a bottom rinse station nozzle.

44. A method as claimed in claim 43 wherein the stream of fluid directed from the top rinse station nozzle is at an angle with the horizontal greater than the stream of fluid directed from the bottom rinse station nozzle.

45. A method as claimed in claim 44 wherein the first predetermined amount of time is equal to the second predetermined amount of time.

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46. A method as claimed in claim 44 wherein the first momentum is equal to the second momentum.

47. A method as claimed in claim 44 wherein the step of directing a stream of fluid onto the slide from the top rinse station nozzle with a first momentum includes turning on a top rinse nozzle valve, the top rinse nozzle valve being connected to a bottle containing fluid, the top rinse nozzle valve controlling the flow of fluid from the bottle to the top rinse nozzle.

48. A method as claimed in claim 47 wherein the step of directing a stream of fluid onto the slide from the bottom rinse station nozzle with a second momentum includes turning on a bottom rinse nozzle valve, the bottom rinse nozzle valve being connected to a bottle containing fluid, the bottom rinse nozzle valve controlling the flow of fluid from the bottle to the bottom rinse nozzle.

49. A method as claimed in claim 48 wherein the step of directing a stream of fluid onto the slide from the bottom rinse station nozzle for a third predetermined amount of time with a third momentum includes turning on the bottom rinse nozzle valve and a second bottom rinse nozzle valve, the second bottom rinse nozzle valve being connected to a bottle containing fluid, the second bottom rinse nozzle valve controlling the flow of fluid from the bottle to the bottom rinse nozzle.

50. An automated biological reaction apparatus comprising:

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a slide support carousel;

drive means engaging the slide support carousel for moving the slide support carousel;

a reagent delivery system for applying a predetermined quantity of reagent to one of the slides by movement of the slide support carousel in a reagent delivery zone;

a heat zone for heating samples on the slide support carousel; and

a rinse station, the rinse station comprising a first nozzle, a first valve connected to the first nozzle through tubing, the first valve connected to a bottle containing fluid, the rinse station further comprising a controller, the controller controlling the flow of fluid from the bottle to the first nozzle via the operation of the first valve, the controller opening the first valve until the pressure is substantially equal in the tubing.

51. An automated biological reaction apparatus as claimed in claim 50 wherein the rinse station further comprises a second valve, the second valve connected to the first nozzle through tubing, the second valve connected to the bottle containing fluid, and wherein the controller controls the flow of fluid from the bottle to the first nozzle via the operation of the second valve, the controller opening the second valve substantially simultaneously with the opening of the first valve until the pressure is substantially equal in the tubing.

52. An automated biological reaction apparatus as claimed in claim 51 wherein the rinse station further comprises a second nozzle, a third valve connected to the second nozzle through tubing, the third valve connected to the bottle containing fluid, a stream of fluid directed from the second nozzle being at an angle with the horizontal greater than the stream of fluid directed from the first nozzle.

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53. An automated biological reaction apparatus as claimed in claim 51 further comprising a volume adjust station, the volume adjust station comprising a volume adjust nozzle positioned above the slide for depositing fluid substantially perpendicularly onto the slide, the nozzle connected to tubing which is connected to a volume adjust valve, the volume adjust valve connected to the bottle containing fluid, the volume adjust valve controlling the flow of fluid from the bottle to the volume adjust nozzle.

54. An automated biological reaction system comprising:

a host device, the host device comprising a processor, a memory device connected to the processor, the memory device including a look-up table which contains steps for staining a slide, the processor creating a sequence of steps from the look-up table; and

a remote device, the remote device being physically separate from the host device, the remote device being in electrical communication with the host device, the remote device comprising a processor, a memory device connected to the processor, a slide support carousel connected to the processor, drive means engaging the slide support carousel for moving the slide support carousel, the drive means connected to the processor, a reagent delivery system for applying a predetermined quantity of reagent to one of the slides by movement of the slide support carousel in a reagent delivery zone, the reagent delivery system connected to the processor, a heat zone for heating samples on the slide support carousel, the heat zone connected to the processor, and a rinse station for rinsing slides on the slide support carousel, the rinse station connected to the processor, the remote device receiving the sequence of steps from the host device, the remote device executing, through the processor, the sequence of steps in the

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processor to control the slide support carousel, the reagent delivery system, the heat zone and the rinse station.

55. An automated biological reaction system as claimed in claim 54 further comprising a plurality of remote devices, each remote device addressable by the host device.

56. An automated biological reaction system as claimed in claim 55 wherein the plurality of remote devices are connected in series with one another, the first remote device in the series being connected to the host device.

57. Method for generating a run program in an automated biological reaction system, the method comprising the steps of:

providing a host device and a remote device, the remote device being physically separate from the host device, the remote device being in communication with the host device;

reading by the remote device of a barcode on a slide in a carousel on the remote device;

reading by the remote device of a barcode on a dispenser in the remote device;

sending of the slide barcode and dispenser barcode from the remote device to the host device;

generating of a sequence of steps for a run based on the slide barcode and dispenser barcode;

determining by the host device whether the remote device is capable of executing the sequence of steps; and

sending by the host device of the sequence of steps to the remote device.

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58. A method as claimed in claim 57 wherein the step of determining by the host device whether the remote device is capable of executing the sequence of steps includes the host device looking in a dispenser look-up table, based on the dispenser barcode, whether the remote device has the dispensers necessary to execute the sequence of steps.

59. A method as claimed in claim 57 wherein the step of determining by the host device whether the remote device is capable of executing the sequence of steps includes the host device looking in a dispenser look-up table, based on the dispenser barcode, whether the remote device has a sufficient number of drops in the dispensers to execute the sequence of steps.

60. A method as claimed in claim 57 wherein the step of determining by the host device whether the remote device is capable of executing the sequence of steps includes the host device looking in a dispenser look-up table, based on the dispenser barcode, whether current date is past the expiration date for the dispensers in the remote device necessary to execute the sequence of steps.

61. A method as claimed in claim 57 wherein the step of determining by the host device whether the remote device is capable of executing the sequence of steps includes the host device looking in a dispenser look-up table, based on the dispenser barcode, whether the remote device has the dispensers necessary to execute the sequence of steps.

62. A method as claimed in claim 57 further comprising the steps of;

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reading by the remote device of a second barcode on a second slide in the carousel on the remote device;

sending of the second slide barcode from the remote device to the host device;

generation of a sequence of steps for a run based on the second slide barcode; and

comparing the sequence of steps based on the slide barcode and the second slide barcode to determine whether the sequences of steps can be executed in a single run.

63. A method as claimed in claim 62 wherein the step of comparing the sequence of steps based on the first barcode and the second barcode to determine whether the sequences of steps can be executed in a single run includes determining whether the temperature requirements for the sequence of steps based on the first barcode are comparable to the temperature requirements for the sequence of steps based on the second barcode.

64. A memory management system for an automated biological reaction apparatus comprising:

a memory device, the memory device including a table containing data for a dispenser used in the automated biological reaction apparatus;

means to transfer the data in the memory device to a host device;

the host device comprising a processor, a host memory device connected to the processor, the host memory device including a look-up table, the processor connected, via the means to transfer the data in the memory device to a host device, to the memory device, the processor updating the look-up table in the host memory device based on comparisons to the table in the memory device.

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65. A memory management system as claimed in claim 64 wherein the data for the dispenser includes a barcode and an expiration date for the dispenser.

66. A memory management system as claimed in claim 65 wherein the look-up table in the host memory device includes data for barcode and expiration dates, and wherein the processor reads the barcode and expiration date for the dispenser and updates the data for barcode and expiration dates in the host memory device.

67. Method for updating dispenser information in an automated biological reaction system, the method comprising the steps of:

providing a host device and a memory device, the host device comprising a processor, a host memory device connected to the processor, the host memory device including a look-up table, the memory device including barcode and expiration date information for the dispenser used in the automated biological reaction apparatus;

reading by the host device of the barcode and expiration date information in the memory device;

updating the look-up table in the host device based on the barcode and expiration date information in the memory device; and

writing in the memory device that the barcode and expiration date information has previously been read.

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68. A method as claimed in claim 67 wherein the step of writing in the memory device that the barcode and expiration date information has previously been read includes setting a flag in the memory device.

69. A method as claimed in claim 67 further comprising the step of checking whether the memory device has been previously read prior to the step of reading by the host device of the barcode and expiration date information in the memory device.

70. A method as claimed in claim 69 further comprising the step of disconnecting the processor to the memory device prior to the step of reading by the host device of the barcode and expiration date information in the memory device.

71. Method for programming a memory device for an automated biological reaction system, the method comprising the steps of:

selecting a form which includes information on numbers and types of dispensers in a kit for the automated biological reaction system;

scanning in barcodes for a set of dispensers;

determining the type of dispenser for each of the dispensers scanned in;

comparing whether the numbers types of dispensers scanned in correspond to the numbers and types of dispenser in the kit form; and

programming the memory device if the numbers types of dispensers scanned in equal the numbers and types of dispenser in the kit form.

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72. A fluid dispenser comprising:

a barrel having a reservoir chamber, the barrel having an upper portion;

a cap connected to the upper portion of the barrel;

a cup check valve, the cup check valve having a first end and a second end, the cup check valve adjacent to the reservoir chamber at the first end, the cup check valve having a cup piece at the second end; and

a dispense chamber adjacent to the second end of the cup check valve.

73. A fluid dispenser as claimed in claim 72 wherein the barrel has a piston adjacent to the reservoir chamber, the piston being in between the reservoir chamber and the dispense chamber, the piston also housing the cup piece of the cup check valve.

74. A fluid dispenser as claimed in claim 73 wherein an edge of the cup piece abut the piston.

75. A valve for passing fluid from one side of the valve to the other side based on a pressure differential between the one side and the other side, the valve being placed in a housing, the valve comprising:

an attachment, the attachment piece being attached to the housing;

a connecting piece being connected to the attachment piece; and

a cup piece, the cup piece being connected to the connecting piece;

the cup piece abutting against the housing when the pressure on the one side of the valve is equal to the pressure on the other side of the valve,

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the cup piece not abutting against the housing when the pressure on the one side of the valve is unequal to the pressure on the other side of the valve.

76. A valve as claimed in claim 75 wherein the cup piece is forked in shape, and whereby the cup piece flexes inward when the pressure on the one side of the valve is unequal to the pressure on the other side of the valve.

77. Method for passing liquid through a housing based on a pressure differential, the method comprising the steps of:

providing a valve having an attachment piece, a connecting piece being connected to the attachment piece, and a cup piece, the cup piece being connected to the connecting piece;

abutting the cup piece against the housing when the pressure on the one side of the valve is equal to the pressure on the other side of the valve; and

flexing the cup piece inward so that the cup piece is not abutting against the housing when the pressure on the one side of the valve is unequal to the pressure on the other side of the valve.

78. A fluid dispenser comprising:

a barrel having a reservoir chamber and a piston, the piston being adjacent to the reservoir chamber;

an extension piece connected to the piston; and

a coupler, the coupler having a dispense chamber, the dispense chamber adjacent to the reservoir chamber, the extension piece moving inside the coupler.

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79. A fluid dispenser as claimed in claim 78 wherein the piston has a hole.

80. A fluid dispenser as claimed in claim 79 further comprising an O-ring, a chamfer, and an O-ring insert, wherein the O-ring seats in the chamfer and the chamfer is connected to the O-ring insert, and wherein the O-ring insert is connected to the coupler.

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